



Life in a pond

Teacher Notes

BIOLOGY
Plant
Physiology

Driving Question:

What is the influence of plants, animals and light on the oxygen concentration of a pond?

Applied Technology: Modeling, simulation

Student Level: High school level (14-18)

Duration: 1 hour

Recommended settings: Student Investigation

Learning Objectives

To investigate the influence of plants, animals and light on the oxygen concentration in a pond

To understand processes which determine the oxygen concentration in a pond

- To understand processes which determine the oxygen concentration in a pond.
- To interpret graphs of oxygen level concentration and light intensity.
- To investigate the influence of plants, animals and light on the oxygen concentration in a pond
- To be able to use a model and modify parameters to simulate the conditions in a pond.
- To adjust and improve a model.

Didactical approach

The model used in this activity calculates the oxygen concentration in a pond. In this simple model the processes of photosynthesis of plants and respiration of plants and animals are responsible for production and consumption of oxygen in water. In the model the following factors can be changed:

- number of plants
- number of animals
- the light intensity.

Students use the model to predict the oxygen concentration in the water and answer the main research question “What is the influence of plants, animals and light on the oxygen concentration in the water?”

The model is based on the following simple concepts:

- In photosynthesis plants produce oxygen. The light intensity influences photosynthesis, the higher the light intensity, the higher the photosynthesis rate.
- Oxygen in water is being used in respiration process as well by plants and as by animals. The respiration is influenced by the oxygen concentration and the number of plants and animals.
- The light depends on the light intensity value. If the light intensity value is equal to 0 then there is no light (dark), if the light intensity value lies between 0 and 100 then the light of constant intensity is generated (value 100 means the maximum constant light intensity) and if the light intensity value is higher than 100 then the periodical changing light is generated. This simulates a day and night rhythm.

Concepts learnt in this activity:

- Respiration and photosynthesis
- Influence of respiration and photosynthesis on the oxygen concentration in a pond.
- Get a overview of the parameters influencing the oxygen concentration.
- Using an modifying a graph.
- Biological equilibrium.

Materials

In your investigations you will use:

- Computer/laptop with Coach

Procedure

- Introduce, depending on prior knowledge, topic modeling in biology. When students have not previously worked with models, it is strongly recommended to discuss the basics of modeling. Let students may first look at a very simple model (see introduction modeling Coach).
- Let students independently or in pairs investigate the model and the questions.
- Students who can use additional challenge, have the ability to modify and / or improve the model.
- Discuss with the students the results and make the connection between respiration and photosynthesis in the oxygen concentration in a pond clear.
- Relate the model of an aquatic ecosystem in the area. If necessary, students can fill measured parameters in the model. Or, on the basis of an existing situation they can adjust the model.

Questions and Assignments

1. Open the Coach Activity 'Life in a pond'.
2. The model calculates the oxygen concentration in a pond over time. Look at the model and explain:
 - Which two processes influence the oxygen concentration in water and in which way?
 - Which variables influence the photosynthesis process?
 - Which variables influence the respiration process?
3. In the model you can change a few parameters (plants, animals, light intensity) to simulate different conditions in a pond. More information can be found in the Coach Activity.
4. Use the model to answer the research question. The questions below help you in your investigations.
 - What happens to the oxygen concentration when there are no plants and animals in the water? (assume light intensity = 50).
Note you can change values of all parameters (animals, plants, light intensity) at the same time or each time explore only one of the parameters.
5. What happens to the oxygen concentration when there are no plants and only animals in a pond?
6. What happens to the oxygen concentration when there are more animals in a pond?
7. What can you say about the effect of animals on the oxygen concentration in water?
8. What happens to the oxygen concentration when there are only plants in a pond?
9. What happens to the oxygen concentration when there are more plants in a pond?
10. What can you say about the effect of animals on the oxygen concentration in water?
11. Assume that in the water there are only animals, what happens to the oxygen concentration in the water when it is:
 - completely dark
 - there is a light
 - the amount of light is changing?
12. Assume that in the water there are only plants, what happens to the oxygen concentration in the water when:
 - completely dark
 - there is a light
 - the amount of light is changing?
13. At which moment of the day is the oxygen concentration in the water the highest; the lowest?
14. How does light affect the oxygen concentration?
15. How do the oxygen peaks match with the light level peaks? Why might the oxygen level reach a peak after the light level does?

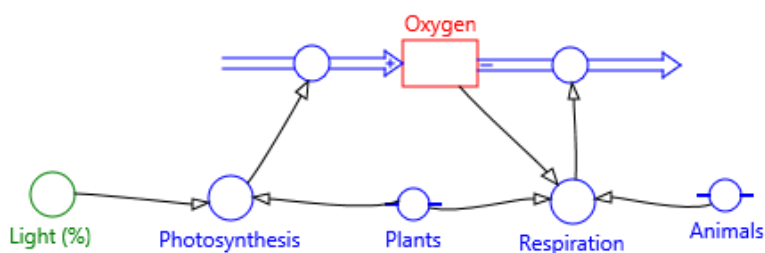
Extra

16. The model is a simplified representation of real processes that take place in a pond. You now know that the oxygen concentration decreases if many animals are present in the pond. You can imagine what happens if there is not enough oxygen in the

water, the animals die. In this model, the number of animals remains the same even though the oxygen concentration is equal to zero. How can you improve model to better describe life in the pond?

Analysis

Students should be able to explain the model and the relations between the variables.



Solved by Euler

In photosynthesis plants produce oxygen. The light intensity influences photosynthesis, the higher the light intensity, the higher the photosynthesis rate.

Oxygen in water is being used in respiration process as well by plants and as by animals. The respiration is influenced by the oxygen concentration and the number of plants and animals. The light depends on the light intensity value (see didactical approach).

Students simulate a different situation by changing the number of plants, number of animals, and the light intensity and observe the oxygen concentration in the water over time. They use their investigations to answer their research question.

After the research question has been answered you can discuss with students possible ways of improving model to better describe the reality, for instance by:

- assuming the relation between the numbers of animals and the oxygen concentration, (if there is no enough oxygen animals die).
- assuming the relation between the numbers of animals and the number of plants (plants serve as food and protection for animals), or
- assuming the relation between the numbers of plants and the number of animals (plants are eaten by animals).

During a discussion concept of biological balance can be applied.

Resources

Coach Activity: Life in a pond.cma7

Coach Result: Life in a pond.cmr7

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